SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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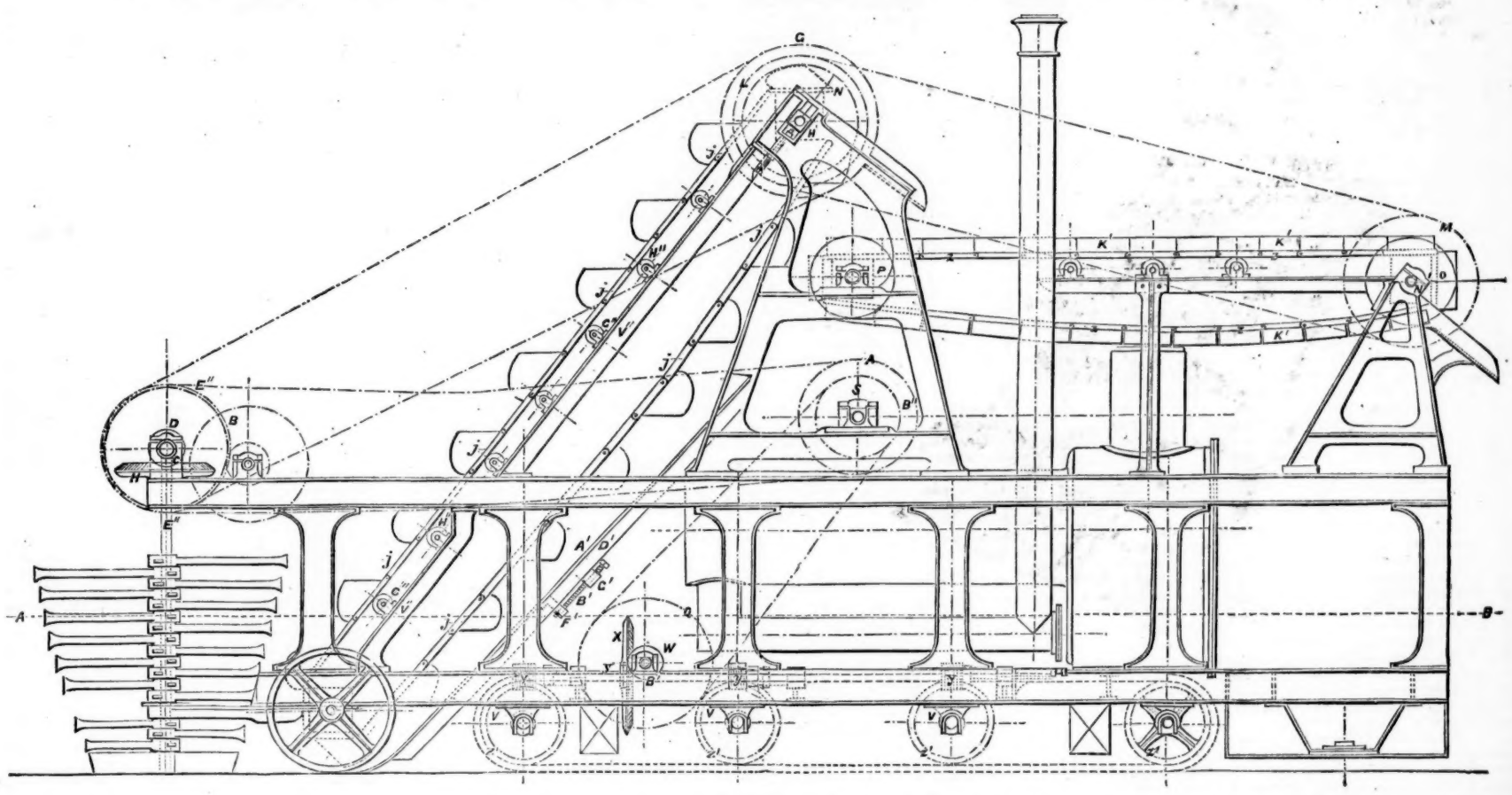
CANAL AND RAILWAY MAKING BY MACHINERY—NEW STEAM EXCAVATOR.



THE VANDENVINNE STEAM EXCAVATOR.

In accordance with the promise contained in the notice of this machine in last week's Journal, the diagram and description of the machine, which will be sufficient to make its principle and action apparent, are subjoined. The improved machine consists of a strong iron framework, in the back part of which is fixed a steam-engine for giving a forward motion to the machine, and for driving its working parts. A pulley is keyed on the shaft of the steam-engine, which drives a second pulley fixed on a horizontal shaft placed in front of the machine; this shaft carries at each end a bevil pinion (or a second shaft may be employed), which bevil pinions gear into two bevil wheels fixed on two vertical wrought-iron shafts, around each of which are fixed a certain number of picks or mattocks (24 preferred), arranged screwwise, forming about a quarter of a revolution, and turning in opposite directions in such a manner that the picks of one of the shafts pass in the corresponding spaces left between the picks of the other shaft; these picks are of the form of a shovel, so as to move the earth, which being struck by the picks is thrown back, and falls into troughs placed to receive it. Curved sheets of iron are arranged, so as to prevent the earth thus moved from falling at the sides. The troughs are fixed on an endless chain passing over two drums, one at the bottom and the other at the top of the machine; the shaft of the top drum is driven by a band passing over a pulley fixed on the horizontal shaft before mentioned; the troughs are thus constantly in motion, and carry up the earth to the top of the machine, and turn it over on an endless chain, which passes over two drums, on the shaft of one of which is fixed a pulley driven by a band from a pulley on the drum shaft of the trough chain; this endless chain thus carries the earth to the back of the machine, whence it may, if required, be carted away. Friction rollers are placed in suitable supports under the endless chain of the troughs, and also under the endless chain carrying the earth to the back of the machine, and at each side of the latter chain sheets of iron are fixed to prevent the earth from falling off, and two iron sheets moved by a screw are placed under the troughs on their descending side to prevent any earth falling into the machine.

In the above diagram A is the pulley keyed on the shaft, S, of the steam-engine driving the pulley, B, which latter is fixed on the shaft, C^1; on the shaft, C, are fixed the bevil pinions, D, which drive the bevil wheels, H, fixed on the pick shafts, E^1, thus causing the movement of the picks, which turn in opposite directions. It is by the movement thus communicated to them that these picks imperceptibly strike the earth together, in such a manner that any obstacles which they encounter—such, for example, as stones, are carried away by the picks into the trough. When the earth falls in the middle of the screw formed by the picks it is at first prevented by a sheet-iron plate, J^1, from falling at the sides; it is pushed into the troughs, which are constantly in movement, and which raise it and turn it over on an endless chain, which carries it to the back of the machine. For this purpose the shaft, C, carries a pulley, E^{11}, which drives the trough chain by means of a pulley, G, wedged on the shaft, H^1, of the drum, N, on which moves the trough chain, J. On the shaft, H^1, is fixed a second pulley, L, which drives the pulley, M, keyed on the shaft, N^1, as is also the drum, O, on which rolls the endless chain, Z; a second drum, P, supports the other end of the chain, Z. The forward movement is effected by means of the pulley, B^{11}, fixed on the shaft, S, driving the pulley, Q, keyed on the shaft, B^1: this shaft carries the bevil pinion, W, which drives the gearing wheel, X, keyed on the shaft, Y. On the shaft, Y, are fixed the three endless screws, Y^1, which drive the gearing wheels, U; these wheels are fixed on the axles carrying the wheels, Z^1 A^1 represents a sheet of iron, which can be raised and lowered at will by means of the screw, B^{11}, the nut, G^1, of which is fixed on the plank, D^1; the screw draws the small support, F^1, fixed to the sheet. These sheets are double, and independent of each other, so that they may be placed obliquely when required. V^{11} represents a bearing piece, on which are placed supports, G^{11}; these supports carry the friction rollers, H^{11}, on which slides the trough chain, J: J^1 represents curved sheets of iron, corresponding to the contour of the screws; K^1, iron sheets placed at the side of the endless chain, to prevent the fall of the earth. The whole machine moves on the wheels, V, V, V, which are carried by the endless railway shown in the dotted lines.

It will thus be seen that the whole apparatus is comprised in one machine, capable of being transported from place to place, and set to work at the desired spot; thus rendering any previous preparation or connection of parts quite unnecessary, which will doubtless be appreciated as an advantage by those of our readers who are acquainted with the inconvenience of having to treat such apparatus as a number of separate and detached machines.

Original Correspondence.

COAL-CUTTING MACHINERY.

Sir,—I have watched with particular interest the progress being made with this class of machinery, knowing, as I do, the wide field before them, comparatively unoccupied, as from some cause or other little progress has yet been made; a large number of machines has been patented since 1861, and almost everyone that has been tried is said to have worked to the satisfaction of the inventors, and those witnessing the trials. Why they do not become general appears difficult to answer. I do not know who is the writer of the occasional articles on this subject in the *Mining Journal*, one of which appeared last week, and I doubt not but the intention of the writer is to do all the good possible towards introducing those necessary and much needed machines, which I have no doubt will ultimately succeed in doing all the laborious work of the collier, but at the same time I am afraid that some who write on the subject pay too little regard for the truth in their statements, and may thereby do more harm than good. It is a well-known fact, and has been clearly shown through the Journal, that the first and most successful "pick coal-cutting machine" ever yet put to work was undoubtedly the one invented by Messrs. Ridley and Rothery The writer also refers to the hydraulic coal-cutting machine of Messrs. Carratt and Marshall, of Leeds, as being in use, and doing well; this machine has, I believe, ceased to exist as a coal-cutting machine years since, and I think the patent has collapsed.

The writer next refers to Mr. Donisthorpe, of Leeds, stating he was early associated with Mr. Firth in bringing out the pick-machine. Mr. Donisthorpe's first patent for cutting coal was a slotting-tool, very much like Mr. Firth's hydraulic wedge, only Mr. Donisthorpe proposed to push it into the coal by hand, and to this slotting-machine he has ever since directed his attention, never once paying the least regard to the pick-machine; he has spent a large sum of money, but never yet, I believe, produced a slotting-machine to do good; the one said to be working at the West Riding Colliery has never yet proved satisfactory to those in whose hands it was placed.

Referring to Mr. Hurd's recent patent, of which you and Mr. Platts, the viewer, who must be a judge, speak in such unreserved terms that it approaches nearer to what is wanted than any yet brought out, I can say nothing, only I wish Mr. Hurd every success. I might at the same time, if you will kindly allow me, give a few remarks by way of caution to Mr. Hurd—that is, to make himself certain there is nothing laid back in those Blue Books ready to be advanced upon him when he has got his machine completed, so that he can, if asked, come forward with some show of justice as the original inventor, for I remember seeing in some of those Blue Books the following statements:—"The engine consists of an oscillating cylinder carried on the same frame for cutting coal," and also a "screwed pillar, by which the cylinder is raised or lowered."

And I think Mr. Leatham, of Leeds, patented in 1865 a "series of air-pumps, plungers, &c., arranged in a radial line—one, two, three, or more, to compress air to work coal machines;" and Mr. Jones has patented "the compressing of air by the fall of water in the shaft, to work coal machines." Mr. Horsfield, of Leeds, has patented "portable compressed air receivers, to be taken from the air compressing engine, to work coal machines when cutting coal," &c. A patent has also been taken out for "air mixed with water or spray, or a jet of water only, to be conveyed into grooves formed by the cutter, to lower the temperature in the grooves," &c. These are points briefly noticed, to call the attention of Mr. Hurd, and other inventors of coal-cutting and breaking down machinery, to how desirous it is to see they are sufficiently clear of all those subtle patentees. An Observer.

Dec. 21.

PREVENTING COLLIERY EXPLOSIONS—DESTRUCTION OF FIRE-DAMP.

Sir,—At present the public mind is happily not excited by any recent colliery explosion; it is, therefore, a suitable opportunity for considering whether there is or is not anything of practical utility in the proposition which was made some years since, though I think it has never received the attention it deserved, for preventing explosions by destroying the fire-damp altogether. I recollect being present at some very interesting experiments made in London, about ten or twelve years since, and the results were all that could be desired, but whether the system was capable of application on the large scale I do not know.

The gas to be destroyed was passed into a small box, in which was a screen, and although large quantities were passed in during several hours a fluid as pure and inexplosive as atmospheric air was all that passed out at the other end. Unfortunately, the discoverer would not state the material with which the screen was filled; and as there were not even facilities offered for judging of the quantity of material rendered useless by each 1000 cubic feet of gas operated upon, there are but few data for concluding what is the probable value of the invention. The use of a chloride as a destroyer was proposed, I believe, by Davy, at the beginning of the century, but in the experiments I refer to the quantity of gas purified in proportion to the size of the screen appeared so large that I was induced to think that some more active material must be employed. I estimate

about 90 ft. of gas was passed through the box whilst I was looking on, and from the size of the box (we were not permitted to see the inside), the material, which must have been a solid, as I insisted on removing the inlet, and outlet tubes, and ascertaining that there was no liquid, and that there was a fair space on each side of the screen, could not have occupied more than 6 in. by 4 in., and 1½ in. thick. With this all the explosive matter in the gas was got rid of, a flame which I held on the exit side being merely moved as with the atmosphere.

Somewhat similar propositions have, I believe, been several times made in France, but I neither know by whom nor the date; I, therefore, avail myself of the columns of the *Mining Journal* as the readiest means of obtaining full information upon the subject, as it is beyond queston that if the destruction of fire-damp could be effected it would be far preferable even to the best system of ventilation that could be devised.—*Dec* 20. —— CUMBRIAN.

NEW PATENT PROTECTOR LAMP FOR MINERS.

SIR,—I was much struck with the notice in last week's Journal of the new patent protector lamp for miners, the special advantage of which is (to use your own words) that in attempting to open it, whether to light his pipe or for any other purpose, the miner is certain first to put the light out. My interest in this matter led me at the earliest opportunity to pay a visit to the patentee, who kindly allowed me to inspect the lamps. I saw the Davy, Clanny, and Stephenson at work, and can fully bear out the truthful description you gave of the new lamp. The great merit of the invention is the extreme simplicity of the appliances used, and the absence of any complicated parts, as by the aid of a pair of hinges within the lamp the simple action of the screw enables the miner to regulate his light as required with the greatest ease, but absolutely prevents the withdrawal of the naked flame, though no lock is used, so that the reckless man can neither endanger his own life or the lives of his fellow-workmen, and which I fear is too often the cause of the sad disasters we have had so frequently to deplore. I understand that it has not yet been practically tested, but, should the lamp carry out in our coal mines the promise it certainly exhibits in the workshop, it seems to me that a new era of safety will dawn on our miners; and, for the sake of humanity, I sincerely trust that such may be the case. I shall watch its progress with great interest when the test has been fully made, and if successful, and the use of gunpowder be strictly prohibited in our mines, I think the risk to our miners' lives will be greatly lessened.
Manchester, Dec. 21. —— D.

PROPOSED GREAT WESTERN MARITIME SHIP CANAL.

SIR,—Your correspondent, "F. H.," whose letter appears in the Journal of Dec. 11, does not seem to comprehend the salient feature in my scheme, which may be briefly described as the conveyance of Welsh coal by a direct water communication to the South of England and the metropolis without breaking bulk. The counter project advocated is merely the extension of the railway system, which is, and must always be, from the expense of maintenance, dearer than transit by water for heavy goods, and has been found inadequate for the end proposed—for, notwithstanding the existence of lines of rail from the neighbourhood of Bristol and Gloucester to the south coast, the produce of the western collieries does not find its way south in any appreciable quantity. The proposal of "F. H." would involve two transhipments, which means labour, loss of time and money; and it would be useless for the colliery owners to compete with those in the Midland and Northern districts under such circumstances, and I submit that the expenditure of 15,000*l.* for a railway from Axminster to Lyme Regis would not attain the object which we have both in view.
King William-street, E.C. —— SUGGESTOR.

THE NECESSITY FOR MECHANICAL AND SCIENTIFIC KNOWLEDGE.

SIR,—There is no question of greater moment to the interests of the State than the education of youth. Upon the proper training of the rising generation depends the future prosperty of the nation. There is no condition of life but that the duties of the station in which the individual is placed is better and more ably discharged in consequence of education than could possibly be the case if ignorance prevailed. All must rejoice, therefore, to see the very general desire which now pervades all classes for greater educational facilities being placed within the reach of all; and it is a matter for the most hearty congratulation to find the present Government fully alive to the necessities of the case, and anxious that every child in the kingdom should be educated, and thus have it in his power to raise himself in the social scale.

But it is not here intended to enter into any discussion as to the necessity and importance of the State providing an education for the children of the country generally, but to enquire whether some means cannot be adopted for the practical education of the youths who will shortly be called upon to fill the places of our most skilful artizans, or to "dig, dive, and delve" into the bowels of the earth for the precious black diamonds which there abound. Whilst admitting the value and importance of the large schools attached to almost every large iron works and colliery in the kingdom, and appreciating the benefit derivable from the various mining schools which exist in different parts of the country, it is evident that these works do not afford that practical education which it is so desirable should be imparted to our young mechanic or the children of the working collier. All know that in France and throughout the continental States far greater facilities are afforded for the education of the youth in the direction now intimated than exists in this country. Public schools are there opened where the youthful mechanic has every opportunity afforded him to develope his ingenuity, and where his efforts are appreciated and recognised. The mechanical arts and sciences are cultivated with greater care and more highly valued, and education of this description is more easily within the reach of all classes in France and the Continent generally, than in England; and it is this steady growth and cultivation of mechanical knowledge on the part of our French and German neighbours, and a corresponding neglect on the part of the youth of England in these matters, which is silently but surely drawing away from us much of that engineering and manufacturing trade which it was once our good fortune to possess.

In making these remarks, it is not in disparagement of our own country. All engaged in its staple trades must believe in its inherent strength, and have faith in its future prosperity. We possess every element for a nation's stability; but, at the same time, the advantages possessed must be appreciated, securely guarded, and turned to account. We must have more mechanical and scientific knowledge for our youth—the capabilities for the development of genius must be multiplied, and our artizans and mechanics taught to appreciate that knowledge which hath power. There are difficulties in the way of giving that education now advocated; but these difficulties are not insuperable—obstacles will have to be encountered in the work, but there are facilities at command which, if properly utilised, would very speedily supply the want now so greatly felt, and soon raise our youth in that mechanical and scientific knowledge which is so desirable they should possess. What at all events would be a partial remedy for that complained of is, that attached to every large works' school there should be an advanced class in which this mechanical and scientific knowledge should be taught. To this class the elder and more intelligent youths should be attracted by means of easy practical lessons, and every possible facility should be afforded them to develope any taste for mechanism and scientific skill they might possess. A very small outlay would be sufficient to fit up a workshop with the necessary appliances requisite for this purpose. The elder scholars should be required to attend this class at least one hour per day, but there should be nothing like irksomeness or "task" connected therewith. The class must be made attractive, and regarded as a reward of merit for proficiency in other branches of education. At least once a year there should be a public examination of the scholars of this class, and those who had obtained the greatest proficiency be rewarded with a medal or other emblem. From what is known in connection with some of the schools of the large works of the kingdom, it is evident there is a wide field for much practical usefulness; and if means such as now suggested were adopted to develope the love for mechanical and scientific knowledge, great good would soon result therefrom. The same remarks will apply with almost equal force to the schools in connection with collieries. The mere rudiments of a mining knowledge taught in the advanced class would do much to instil into the minds of the youth a thirst for more scientific knowledge, especially when they know that in all probability they will have to follow in the footsteps of their fathers. The dangers attendant upon improper ventilation could be easily shown by means of models and diagrams, and thus some steps taken in the right direction to prevent the frequent occurrence of explosions.

But whilst the large iron manufacturers and colliery proprietors can do much to inculcate a love for mechanical and scientific knowledge, Government can powerfully second their efforts. Some of the greatest authorities contend that it is the imperative duty of the State to provide education for every child in the kingdom, quite as much as to provide soldiers and police for our safety. Probably, the compulsory education of every child in the kingdom will form the basis of the Government scheme of education to be introduced during the next session of Parliament; and if such should be the case, the claims of the children of our mechanics and colliers should not be overlooked. In all the great centres of mechanical manufacture, and in the locality of collieries, schools especially adapted to teach mechanical and scientific knowledge should be opened, and every encouragement held out for the children of our engineers, mechanics, &c., to enter these schools, and obtain that special education which will be of such advantage to them in after life.

The subject now alluded to is more intimately connected with the present and future prosperity of this kingdom than the first cursory glance would intimate. If it be true that our French and continental neighbours are fast rivalling us in the manufacture of engines and machinery generally, upon which we are so wont to pride ourselves, it is proof that they devote themselves more to the study and practice of mechanical skill than we in England do, and take advantage of our apathy and indifference in the education of our children in the direction now referred to. Let us look our position then steadfastly in the face. We have weak points in the battle of commerce which require strengthening. The neglect of the education of our youth in mechanical and scientific knowledge is, unquestionably, one of our very weakest points. It must be remedied, if we would still lead the way in the onward march of trade and commerce. With the abundant supply of coal and iron, England is richer than any of our continental neighbours. Our merchants are as enterprising as ever. We have more capital at command at the present moment than during any previous time in the history of the country. In none of these things can any continental State compare with us. We compete, therefore, with every advantage on our side. In mechanical and engineering skill and in scientific attainments our neighbours, however, are fast out-rivalling us. Let us see to it for the future. We know our weak point. Let us strengthen it; and, whilst calculating our natural advantages, let one and all do everything which lies in his power to provide for the mechanical and scientific education of the country. The necessity for this knowledge once fully recognised by the large employers of labour and manufacturers, and also by the Government, and the love for its pursuit once inculcated in our youths, there need be no fear for the future prosperity of those staple trades and manufactures upon which England's greatness has been built, and by means of which she must still maintain her present proud position amongst the nations of the world. JUDEX.
London, Dec. 22.

A SHORT HISTORICAL SKETCH OF METALLIC ZINC.

SIR,—If we may depend on the traditions and records of the Chinese, we learn that they were acquainted with metallic zinc at a very early period, and we must ascribe the first discovery of the metal, like that of so many other concomitants of our modern European civilisation, to the inhabitants of the East. The fact is that the metal was imported from India by the Portuguese, in the seventeenth century, under the name of spianter, or spialter, before its nature was recognised in Europe. Whether the ancient civilised nations of the West were acquainted with metallic zinc cannot be ascertained, but there is a great probability that they were. The high degree of development of some of the ancient nations on the shores of the Mediterranean with regard to metallurgical operations, their very extensive manufacture and use of brass, make it most likely that they knew also metallic zinc, and some way of extracting it from its ores. It is true that the writings of the old Greek and Roman authors do not refer to it; it appears, on the contrary, that they regarded brass and yellow metal as only a coloured copper, and the Greek word "chalkos," as well as the Latin word "aes," meant both copper and brass, though some authors, as Strabo and others, used sometimes the word "aurichalcum" for the latter. This, however, only related to the colour, and meant nothing but a gold-like copper. If we consider the difficulty of communication, the continual and violent political revolutions in the ancient world, the absence of all the present facilities for spreading and preserving any knowledge—further, the fact that our historical sources consist chiefly of the fragmentary writings of a few philosophical scholars, we may easily conceive the possibility that some ancient knowledge may have been entirely lost to us. Our oldest historical documents are the writings of Aristoteles (fourth century B.C.) and Dioskorides (third century B.C.); they only refer to the manufacture of brass, by admixing an earthy substance ("kadmea") with the copper. The latter author also mentions the application of zinciferous deposits from the brass kilns for the same purpose, and distinguishes from it the white oxide or flowers of zinc, under the special name of "pompholix." In his description of the latter substance he compared its appearance to that of wool, which gave rise to the newer alchymical name of "lana philosophica," much used by the authors of the middle ages.

As in general, the principles of the Alexandrian scholars, and especially those of Dioskorides, were forming the foundation of natural science for a long period; so it was also the case with regard to their views on brass, and the other zinciferous substances. The following Roman authors—Pliny, sen. (first century, A.D.), Strabo (first century, A.D.), and Festus (fourth century, A.D.), who left us some treatises on natural history—adhered to those principles, and throughout the whole middle ages, down to the latest time, we find them prevailing; the only thing worthy of remark for our purpose during that period is the origin of some words relating to zinc.

From the fifth century, A.D., we find the name "jutia" employed instead of "kadmea" or "cadmia," as well for calamine as for the zinciferous furnace deposits. Zosimus in the fifth, Geber in the eighth, and Avicenna in the eleventh century make use of it in their treatment on brass smelting. Some Arabian authors, also, employed the word "climia" or "calimia," synonymously with "jutia," from which words subsequently calamine or "lapis calaminaris" was derived. The latter word appears first in the writings of Albertus Magnus, in the thirteenth century. He made a distinction between "calaminaris" and "jutia," applying the former word to the natural mineral, and the latter to the zinciferous furnace deposits, and considers them both equally applicable to brass making. The word "zinc" or "zinken" is of later origin. We find it employed, first, in the fifteenth century by Basilius Valentinus without, however, any clear definition accompanying it, which even leaves it uncertain whether he meant a metal by it or some other zinciferous substance. The first who described metallic zinc by that name, and undoubtedly in accordance with some of its real properties, was Paracelsius (sixteenth century), although it would appear that his notion did not generally prevail, for down to the end of the seventeenth century a general confusion existed about the use of the word. Some authors employed it for the zinciferous furnace deposits, some for bismuth, cobalt, and other metals. It was only at the commencement of the eighteenth century that the ideas on the nature of brass and zinc became clearer. Kunkel announced in the year 1700, and Stahl conclusively in 1718, that calamine required to be reduced to zinc before it would combine with copper during the brass smelting process. The notion prevailed, however, for some years afterwards that a reduction of calamine into metal was only practicable when copper was present, until Schwab in 1742, and Markgraf in 1746, published some methods of zinc distillation by means of fire-standing retorts.

From this time we meet also with credible records of practical enterprises for carrying out the distillation of zinc on a large scale. For many centuries three districts in Europe were chiefly noted for producing zinc ores—some parts of the South of England, the neighbourhood of Aix-la-Chapelle, near the Rhine, and the environs of Beuthen, in Upper Silesia. It is certain that the calamine mines of Altenberg, near Aix-la-Chapelle, have been worked from about the year 1430. In 1565 the first concession was granted for starting a calamine mine, near Beuthen, in Silesia, where many mines were soon after opened, of which the Scharleygrube was, and is still, the richest. At all these places the ore formed an important article of trade, and was sent (especially from Aix and Beuthen) to the various distant brass works. It is obvious that from these places the first efforts proceeded for extracting metallic zinc on a large scale, and in England Dr. Isaac Lawson seems to have been the first who suceeded in introducing a practical method for that purpose; certain it is that in the year 1758 a patent was granted in the name of Champion for a method of extracting zinc from blende, called at that time "black jack," "mock jack," or "bragill." The first works were erected in the neighbourhood of Bristol, and were described by Waston, who visited them in 1766. According to his reports, their method was very similar to that in use in England to so recent a period as 20 years ago; it was a "destillatio per descensum," and forms the basis of the old English system for reducing zinc. In this process the distillation took place in closed crucibles; the volatilised zinc was made to pass through an orifice at the bottom of the crucibles into a vertical iron tube, where the vapours of the metal were condensed, and dropped into a vessel containing water standing beneath it. The furnaces used were either rectangular or round, with a fire-place in the middle, surrounded by the crucibles. This method was the only successful one employed throughout Europe for about 50 years, and it attained considerable development, so that it competed for even 20 or 30 years longer with the newer methods, which are now generally adopted under the name of the Belgian and Silesian systems, and which are more open to modifications and improvements. Both these systems originated about the beginning of the present century, when almost contemporaneously (in the years 1808 and 1809) patents were taken out by the Abbot Donny at Liege, and J. Chevalier Ruberg at Wessola, in Silesia, for new methods of reducing zinc.

The principal difference between the three methods mentioned lies in the form of the clay vessels or retorts introduced for the reduction and distillation of the metal. In the English process that vessel consisted of a large crucible, in the Belgian it represents a cylinder, and in the Silesian process a somewhat oblong, flat-sided tube, termed muffle. It is hardly necessary to say that this difference in the shape of the retorts arose originally from the way which the inventors found to succeed best in their first trials to extract the metal. Ruberg, for instance, performed his first experiments by means of a common assaying muffle, as used for cupellation. These muffles are generally of a semicircular front, and so we find them also employed for the zinc smelting process in Silesia to about the year 1835, only of larger size. The peculiar shape of the retorts influenced the arrangement of the furnaces of the different systems. Of the Belgian tubular retorts several horizontal rows could be placed in one furnace, forming an arched chamber with a fire-place beneath, whilst the flat-bottomed muffles only allowed of the arrangement of a single horizontal row along both sides of a fire-place, covered over by a flat arched vault. By such a disposition it was practicable, both in the Belgian method as well as in the Silesian method, to fix the condensing apparatus entirely outside the furnace, convenient to the workman, and facilitating as much as possible the operations of charging and discharging the retorts. This is one of the great advantages which the two newer systems exhibit in comparison with the old English one. Another is in the practicability of enlarging the furnaces, the original size of which was undoubtedly small. Even the first improvements were not as much directed towards the enlargement of the furnaces as towards that of the retorts. In the first place the necessary temperature for the reduction of the zinc ores, and especially the great advantage of a swift process, were under-estimated. Most of the Silesian zinc works to the year 1835 employed muffles of 18-in. width inside, which of course only required to be charged once every two or three days, without even then allowing of a complete exhaustion of their charges. Similar anomalies we meet with also in the Belgian system. The size of the retorts forms, no doubt, one of the most important elements in the zinc smelting process, and the development of our two present methods is chiefly due to the recognition of this fact.

It has been mentioned already that in the second half of the last century the first zinc works were commenced in England; so also the discovery of the two methods in Belgium and Silesia was soon followed by erections of zinc works in those countries. The first one in Belgium was that of St. Leonard, at Liege, and in Silesia the Lydogniahuette, at Kœnigshuette, both starting about the years 1809 and 1810.

However, the practical application of metallic zinc was still at that time a very limited one. Zinc was regarded as a brittle metal, not suitable to be worked by itself, and though Hobson and Sylvester, at Sheffield, proved by some experiments in the year 1805 its ductility and fitness for being rolled into sheets, the only application of it was to the manufacture of brass and yellow metal; but even for this purpose the use of calamine was kept up for some time. No wonder that the demand for spelter, and, consequently, the activity of the smelting works, were very limited. At intervals, under the influence of speculation, the price of the metal advanced sometimes to a considerable extent, but only to decline afterwards. No metal has undergone in modern days such extremes in price as spelter; frequently we find it varying on the Continent from 10*l.* to 75*l.* per ton within the last 50 years, and it is obvious that such a state of things could not be favourable to the development of the spelter trade in general.

Step by step, however, this unsteadiness ceased with the rapidly spreading recognition of its almost unparalleled advantages for many technical purposes. Great progress was made in this direction by the successful application of the metal to artistic and monumental castings, applied first at the Royal Iron Foundry at Berlin in the year 1833. Even in the earliest times bronze was proved to be the metallic substance most suitable for such castings, and it will, no doubt, continue so for the classic monumental art. The costliness of bronze, however, limits considerably the common use of it in the ornamental line, and the want of a more generally applicable substitute led long ago to many experiments with cheaper metal, as, for instance, cast-iron, and even lead. The difficulties connected with the casting of large iron statues, and with the chiselling of them afterwards, are great points against the use of this metal, whilst its exceeding softness, ponderosity, and consequent instability, render the latter almost unfit for the purpose. Zinc, on the other hand, offers, by its natural properties, and its comparatively low price, every qualification for it. The only difficulty in its employment lay in the method of casting. Experience showed that full round castings of zinc would not succeed by means of the traditional closed loam moulds, and it is the merit of the above-mentioned foundry to have introduced a new method which offers many considerable advantages over the old one. The principle of this new method lies in the casting of zinc in different parts in open sand-moulds, and in joining such parts afterwards by soldering. This process has now been brought to extraordinary perfection, and united with some modes of pressing sheet-zinc into ornamental articles, and of producing small hollow castings by means of cast-iron moulds, forms the principal industry of large establishments.

Great progress in the application of zinc was also made by substituting it for tin as a protecting coat for iron articles, chiefly for iron sheets for roofing, &c. The first patent for coating iron with zinc was granted to Mr. H. W. Crawfurd in 1837. His process, described in the "Repertory of Patent Inventions," is almost similar to that still in use at our present galvanising works. It consisted briefly in cleaning the iron objects by immersion in a bath of water, acidulated with sulphuric acid, scouring and washing them afterwards, and dipping them into melted zinc, covered with a layer of sal-ammoniac. They were then slowly removed, to allow the superfluous zinc to drain off, and thrown, whilst hot, into cold water. Iron treated in this way shows a great resistance to the destructive influence of the atmosphere, and the application of this process, therefore, came soon into general use. We may estimate the quantity of spelter now consumed in Europe for zinking or galvanising purposes to be above 10,000 tons per annum. The above-named properties of zinc rendered it one of the most useful metals; and, moreover, if we add to this its high im-

portance for the electric telegraph, and its enormous consumption in the form of sheets, as well as oxide, we can readily account for the present great development of the spelter trade. It is impossible to name all the purposes for which zinc sheets have been introduced, with almost unparalleled success during the last 30 years, and the number is still evidently increasing. It will, probably, be the subject of an extra paper to go more extensively into this matter, in connection with the rolling process, and the manufacture of zinc oxide.

With the beginning of the fourth decenary of our present century we find metallic zinc to have gained ground so far in manufacture and art, that it appeared quite indispensible to them. In the chief calamine districts of Europe large companies were formed for extracting and working the metal, and, though some great fluctuations in the zinc market were experienced, as, for instance, in the years 1848 and 1849, when the price of zinc in Breslau (capital of Silesia) declined to an average of only 11*l.* 5*s.* per ton, yet a rapidly increased demand, and a proportionate production, always followed. The average price of spelter has been for the last 20 years about 20*l.* per ton; the maximum price during this period was that of the year 1857, when it averaged 27*l.* 6*s.* per ton, and the minimum that of 1861, with an average of 15*l.* 7*s.* 3*d.* per ton at Breslau.

The yearly production of spelter in Europe amounts now to 100,000 tons at least, of which quantity about 50,000 tons are made in North Germany, 35,000 tons in Belgium, and 15,000 tons in England. The largest establishments for smelting and manufacturing the metal are those of the Vieille Montagne Company, in Belgium; the Schlesische Actiengesellschaft, in Silesia; and the works of Messrs. Vivian and Sons, in England. The metal has attained an importance through the whole civilised world, which places it amongst the most valuable treasures of national wealth in several countries, and ranges it by its applicability and cheapness next to iron amongst our most useful metals. Large quantities are annually exported to the remotest places of the globe, and it is curious, and no less satisfactory, to note the alteration in the direction of the spelter trade. Two hundred years ago we find the metal was exported from India to Europe; now large shipments of it (by far larger quantities than we ever received) are being made from Europe to Asia. F. A. THUM.

Bagillt, Flintshire, Dec. 20.

LIQUID FUEL.

SIR,—It was some time since stated that liquid fuel had been very successfully employed in the re-heating of iron, I think at Deptford, and I should be glad to learn whether its use has been continued, and whether equally good results have been obtained. The invention to which I now allude was that of Messrs. Dorsett and Blyth, and consisted in first converting the hydrocarbon oil into gas, and then applying the gas to the purposes for which it may be applied. Upon the little steam-vessel to which the system was applied, and at the boiler-works at Deptford, the invention seemed to work admirably, but what I should like to know is, whether there was any difficulty in converting the whole of the fluid into gas, or whether there is any non-volatile residue left in the gas-producing chamber? In estimating the commercial importance of the invention this is a very important question, for not only would it have a material effect upon the number of cubic feet of gas produced from each gallon of hydrocarbon liquid used, but it would make a material difference in the cost of keeping the apparatus in proper working order.

It is upon this consideration that I should be inclined to give the preference to Aydon and Field's principle rather than to Dorsett and Blyth's, in which it seems to me that an unvolatisable deposit would be inevitable. But in Aydon and Field's arrangement the case is widely different. The whole of the liquid is delivered into the furnace in the shape of spray, and in this form it is completely burned; or if there should happen to be a slight residue left, as it were, in the ashpit, and not in the working parts of the apparatus, Messrs. Aydon and Field's system of burning the fluid ensures the complete combustion of the fluid.

But the difficulty which seems to me equally likely to arise with the Doreett and Blyth and with the Aydon and Field systems is the absence of a sufficient quantity of the raw material which they propose to employ as a fuel in the market as an ordinary article of commerce. The spray system is, without doubt, admirable, and I think a larger proportion of the fluid is consumed than by any process I have seen, but there is a great waste of power, and very slight impurities in the oil used would choke the apparatus altogether. I am still inclined to think that coal is the most economic fuel that can be used in England, hut at the same time I am quite ready to admit that where liquid fuel can be obtained at a low rate, as it, doubtless, could be in many parts of the world to which English ships trade, the adoption of such an invention as that of Messrs. Aydon and Field would be of immense commercial advantage.

Dec. 20. R. C. J.

LEAD AND COPPER MINING—LORDS' DUES.

SIR,—Cornwall has hitherto been the great mining county, and has produced, and still produces, enormous quantities of mineral wealth, but upon examination of the list of dividend mines it will be found that the produce of the chief of them is either tin or lead. Copper mining in this county is decidedly upon the decrease, owing to the increased depth of the richest mines, the low standard, and the influx of richer ores into our markets from foreign countries. There are at the present time several mines working which return monthly many hundred tons of ore, with the proceeds of which they can hardly pay their way, and, indeed, a great many cannot even do this, but are a continual drag upon the shareholders; nor is this to be wondered at when we find that the average value of a ton of this ore is only about 4*l.*; therefore, it stands to reason that to work these deep mines at a profit, this low-priced ore must be found in large quantities. During the past few years, several deposits of rich ore have been discovered in both North and South America, also in other countries, some of which can be worked and imported to our markets to compete with our own produce; therefore, I do not think we can expect any very great improvement in the price of this metal. For the future, if Cornwall is to compete with the world, these deep and expensive mines must be abandoned, and virgin ground sought for, where lodes may be worked without the aid of ponderous pumping machinery.

Although lead mining has proved, upon the whole, far more remunerative than copper, it has been greatly neglected by capitalists until within the last ten years, and especially in the Principality of Wales, which is undoubtedly richer in this metal than any other part of the United Kingdom. A stranger would naturally ask why Wales should have been neglected more than Cornwall? One reason has been that hitherto the majority of Welsh landowners have asked exorbitant premiums before they would grant their lands, also something handsome in the shape of "dead rent," and, to crown all, a royalty of an eighth or tenth of all minerals raised, which latter of itself would be sufficient to disgust any man who had been accustomed to Cornish mining (where the royalties range from a fifteenth to a thirtieth). However, the landlords have at last discovered the futility of demanding such unreasonable terms, for capitalists will *not* develope mineral properties for the almost entire benefit of the lords; consequently grants can now be generally obtained upon equitable conditions, and as this spirit of liberality continues to improve so the influx of capital will increase, and it is to be hoped to the advantage of both the landowner and capitalist. Since the discovery recently made in the far-famed Van Mine, several *little* Vans have sprung into existence, some of which have very good chances of success, while others are simply worthless; and I would here caution intending speculators to be wary as to what they touch, more especially as regards those mines in the immediate neighbourhood of the Van. Because the Van itself is rich it does not follow that the adjoining ground will prove equally so, on the contrary, it is almost invariably the reverse. Where, for instance, are there rich mines in the immediate neighbourhood of Minera, Hendra, Talargoch, Maes-y-Safn, Melor, and several others I could mention. I am of opinion that where Welsh mining ground is properly selected, and placed under the management of practical men, the majority of such properties will prove to be remunerative. Of course, it cannot be expected that all will turn out well, and lodes sometimes, however "kindly" the appearance, will prove deceptive to even the most experienced, and it must be remembered that a good miner cannot always make a good mine, although it is said "a good bal always make a good capen." ALFRED THOMAS.

3, *Great St. Helen's, London, E.C.*

PRACTICAL MINING—TREATMENT OF POOR COPPER ORE.

SIR,—In the report of the Miners' Association of Cornwall and Devonshire, to which reference was made in last week's Journal, there is an article of great practical value, translated from the Italian by Dr. Clement Le Neve Foster; and, upon carefully reading it, the question occurs to me whether the process, which seems to want very little labour, and to be very cheap, could not be applied with equal success to our own ores. The ore at Agordo seems to be a copper pyrites, and this is one of our very common Cornish ores; but I do not know if the admixture of iron pyrites would lead to failure. Dr. Foster says that when roasted nearly the whole of the copper is collected as sulphide in a kernel in the centre of the lumps of ore, while the outer part contains only a small quantity in the state of oxide and sulphate. This state of things appears to me to be due to the mode of roasting, and I think it might be of some advantage to the Cornish mines if the ore were concentrated by this means before being sold to the smelters. Of course, the good ore would be sold as at present, but this Agordo process can be used with ore down to less than ½ per cent. produce, and which at present is almost valueless—often quite so.

There are many places in the county where heaps of refuse ore of 3000 tons could readily be tried, and they would often give more than ½ per cent. produce, and if these could be made marketable it would go a great way towards paying the cost of working the mine. You see it gives you the sulphur as sulphur, and this sells at a higher price than any of the Cornish ores of copper; and if it is only the mode of roasting I do not see why we should not get a saleable article instead of one with which we can do nothing. The sulphur in the ore seems to be the chief ingredient with which the calcination is carried on, so that our ores ought to do just as well as the Agordo ores, and, as the process would only be applied to ores which are now almost unsaleable, it could not interfere with profits, except to increase them.

The prices paid at Agordo, with the exception of wages, are quite as high as in England. For every ton of rosette copper obtained they consumed 77¾ tons of ore, at 8*s.* 7*d.*, 1½ ton of scrap iron, at 6*l.* 2*s.*, and 4½ tons of sandstone, at 6*s.* 1*d.* per ton. The chief other expense is for fuel, and in this respect I think England is quite as well situated as Italy. The only point on which a doubt could arise is the water-power, with which Agordo is abundantly supplied, so that the cost of raising the ore is as low as possible, but I do not see that this is a matter of great importance, as in Cornwall the refuse ore would be treated—in fact, the adoption of the kernel roasting process should be altogether supplementary to the present system of mining. The cost of the necessary plant would be very small, and if the same results could be obtained in England as at Agordo, I believe adventurers would never regret the outlay. MINER.

Dec. 21.

MINING IN CARDIGANSHIRE.

SIR,—On Thursday last I inspected the Esgair Llee Mine and likewise the Castell, and from the appearance of the lode in the former I can say that for many years I have not seen a more promising and, so far, productive lode. As I have before referred to this mine, I will only add that the levels now being driven east and west at the bottom of the mine, and also a winze which is being sunk from the level above (west), are looking very well. This speaks much for the old mine to the east, within 100 fms. of the boundary, and within 60 fms. of the river. The sett has been taken up by a party of gentlemen, who intend working it energetically. I wish them success.

Castell Mine is to the west of Esgair Llee, and can be seen one from the other in a beautiful valley, the Castell river running at the foot of the two mines, winding its way on to Ponterwyd village, where under the old mill it plunges into the Rheidol stream, and is carried down to the sea. The Castell Mine is worked chiefly for the enormous quantity of blende it contains, although they have three lodes running parallel, in one of which I broke as pretty a lump of lead as I ever saw, and this, too, within a few fathoms of surface. These lodes and all their workings are to the south of the river, and also the Esgair Llee lode, which is supposed to traverse this valuable mine sett. Their chief works at present are on the central lode, the engine-shaft being down 17 fms. under their present bottom levels; from this shaft a cross-cut is being driven to intersect the lode, when they anticipate a fair share of lead as well as blende; and for my part I see no obstacle, as the lodes of this locality have all more or less been capped or ridden, even to a depth of 50 or 60 fms., with blende, which in depth gives way to lead. This will doubtless be the case in this mine; and, judging from the character of the ground and the appearance of the lodes, which are very large, and carry themselves in a bold and proper form, I have no hesitation in saying that I believe this mine, properly worked with a good spirited company, will be as good in time as its neighbours, the two Esgair Llees being immediately to the east, and having the Ponterwyd range of mines on the west. The manager, Mr. Lynch, is doing his best with his agent, Capt. R. B. Harvey, to get a good parcel of blende ready for market. The working of the mines will be hailed with satisfaction throughout the district, from the increased employment it will give.—*Rhysgoch, Dec.* 22. SAMPSON TREVETHAN, JUN.

CHONTALES NUGGET TELEGRAM.

SIR,—The letter under this head from Brother Jonathan, published in last week's Supplement, was very amusing and instructive. Anyhow, it does not alter the fact that the San Antonio Mine has greatly improved in value, and we have also the highly satisfactory confirmed news of the termination of the civil war. Without a doubt Mr. Belt, at the earliest opportunity, will make a large addition to the present small native force, and we shall then soon see returns of gold rendered at a much less cost than formerly, considering the water power improvements, &c., lately added to the already existing steam plant. I do not despair, although I hold a respectable number of shares, which cost me par. I am quite at ease with respect to Mr. Belt, knowing him to be the right man in the right place. Then again, I have full faith in one of the best body of executives (with our practical worthy managing director) in the City. These gentlemen's combined efforts will yet put a new face upon matters relating to this company, which is destined to hold a high position. There is still a decent balance in the hands of Messrs. Lacayo for Mr. Belt to work upon, and any further capital may, perhaps, be unnecessary. Should the amount of the unissued debentures be required, then let us all rally round and take our p[illegible].

I do not trouble at all about the Nugget Telegram, have always fancied from the first that it was too good to be true, but there might be a rich discovery made of gold-bearing ore in San Antonio or elsewhere. Anyhow, without a doubt, upon further exploration plenty will be found in Consuelo and the several mines. I could easily have sold my shares at 3*l.*, but if there is a discovery of any sort I shall be better paid—if not, I have the satisfaction of knowing we still possess the several very rich mines, which only require a little more patience for development; and I do believe our worthy practical commissioner, Mr. Belt, will yet place the company in a respectable position. Now the war is over I look to a rapid turn of the tide, as much in our favour as it has been against us. All the present gold-producing mines have had their primary difficulties, and we are having ours for our future benefit. They are rapidly drawing to a close, and a bright future for the New Year is the wish of an—

London, Dec. 21. ORIGINAL SHAREHOLDER.

THE VIRTUOUS LADY MINE.

SIR,—This new undertaking is now beginning to take a hold on the minds of those who are looking for investments in sound and healthy mining adventures. I have watched the correspondence in the Journal with much interest, and cannot but feel that the Virtuous Lady has, unfortunately, suffered much in the estimation of moderate and thinking business men from the very strong and florid statements put forth on its behalf by Mr. Barnard. I have taken the trouble frequently to visit the mine, and put Mr. B.'s strong statements to the test of actual examination on the spot, and I am bound to admit that when that gentleman has not indulged in prediction, and confined himself to facts as they have been laid open week after week, the statements he has put forth have been most remarkably, and to some extent unexpectedly, confirmed. I am quite convinced that he has always believed his statements, and even his prophecies, but calculating business men are in the habit of looking for something more tangible than predictions before they invest their money; and, under this feeling, I have made it my business, at considerable expense to myself, although living at the distance of a four hours' railway journey from it, to visit the property frequently, and judge for myself as to what I could see and learn respecting it, quite independently of Mr. Barnard.

The present state of the mine, which is verified by my personal inspection up to last Saturday (the 18th inst.), fully sustains the statements of facts and indications as put forth in your columns. I took a large interest in the mine very early after it was laid before the public, and I do not intend to part with that interest if the shares were to attain, as I believe they very soon will, double their present price. My reasons for this good opinion are these:—It is a large sett, of the most richly mineralised ground; its depth is under 20 fms., and from the various levels a very great quantity of rich ore has in its former workings been taken away. By the erection of a water-wheel the mine has been unwatered within six weeks from the time it was commenced, and a considerable number of miners are now actually breaking rich ore from the old workings. This was not expected; but it is the fact, and the strong east and west lodes are fast coming together, and will very shortly open out vast quantities of ore. The machinery to efficiently work the mine is all erected except the crusher, and that is now being proceeded with. All this machinery is paid for, and a large cash balance is in the hands of the company's bankers, sufficient to sink the mine many fathoms deeper, and pay for cross-cuts, which will intersect four or five strong and large lodes, even if a single ounce of copper ore were not obtained; but in the short time the men have been at work while the mine was being cleared of water more ore has been broken and ore ground laid open than would be required to pay for dead work for the next three or four months. I take it, therefore, that the establishment of the mine as a reality is a fact already accomplished—and, further, the quantity of high-class ore within reach and shortly to be reached is practically unlimited. The mine is in the hands of a most courteous and conscientious underground agent, Capt. Henry Horswell, assisted by the mature experience and equally conscientious advice of Captain John Gifford, of the Prince of Wales and other mines. All these and others I might give are reasons why I feel the strongest confidence in the future of the Virtuous Lady Mine, wholly independent of the strong letters of Mr. Barnard.

Last week you published six assays of ore broken from Hawkes' pitch, by Dr. Phipson, and as I have seen this pitch, and know that it contains very large masses of rich ore, which will cost to get no more than quarry work, I have taken a little trouble to ascertain its value as compared with the copper ore sold at the Truro and Redruth ticketings for 1869. I have taken the sales reported in your columns, held from Dec. 31, 1868, to Dec. 9, 1869, inclusive, and find there have been forty-two sales of ore raised in Devon and Cornwall, and that the average money value per ton of ore in the two counties has been 4*l.* 0*s.* 11*d.* With this compare the six assays of Dr. Phipson and their money value, assuming the units at 13*s.* The result is—

No. 1	Copper	24·9	Worth	£16	2	7
No. 2	,,	16·00	,,	10	8	0
No. 3	,,	8·42	,,	5	9	3
No. 4	,,	12·17	,,	7	18	3
No. 5	,,	11·94	,,	7	15	3
No. 6	,,	26·5	,,	17	14	6

Giving an average value of 10*l.* 10*s.* 9*d.*

This, you will observe, is for copper only; but the same assays gave silver in the same samples, yielding respectively 8¾ ozs., 9½ ozs., 6½ ozs., 7 ozs., 10 ozs., and 10 ozs.—all broken from a rock sent to London for inspection, weighing about 5 cwts., and of which there are many tons laid open in the mine now being broken away.

Your readers will agree with me in thinking that, without the use of a single strong expression, the Virtuous Lady Mine has established its reputation as a first-class property, with every indication of permanence. I assure you I am well pleased to subscribe myself, though not a promoter—

A SHAREHOLDER.

[For remainder of Original Correspondence, see this day's Journal.]

FOREIGN MINING AND METALLURGY.

The general state of the Belgian coal trade may be described as one of prosperity. Prices have been maintained with remarkable firmness, and several qualities have even displayed a strong upward tendency. This tendency has appeared in all the basins, and for several months past every week has witnessed a fresh improvement in the movement of affairs. Stocks have generally diminished; where they have not disappeared, they have been greatly reduced. Freights remain without variation. The state of the Belgian metallurgical markets has not experienced any material variation. The works continue to execute the numerous orders which they have undertaken, and which will assure them employment for some time to come; but no fresh fact has occurred which is worthy of special notice. The scarcity of casting pig has made itself more sharply felt; and as the imports of English pig have sensibly declined in importance during the last few months, an advance has taken place in prices, and the tendency in favour of the erection of additional blast-furnaces has been strengthened. The Bonne Esperance Colliery Company will pay Jan. 2 a dividend of 1*l.* per share on account of profits realised during 1869. The Ougrée Collieries and Blast-Furnaces Company will pay Jan. 2 a dividend of 16*s.* per share in respect of profits realised during 1868-9. The Thy-le-Château Blast-Furnaces and Forges Company will pay Jan. 2 statutory interest upon its shares for 1869.

There has been a good deal of business done in iron and casting pig on the markets of the Haute-Marne; at the same time prices show little change. The Champagne forgemasters hope that the advance which has just taken place in the Centre and South of France will allow them to increase their business relations with Lyons and the Loire. Iron from coke-made pig is quoted at 8*l.* to 8*l.* 4*s.* per ton; mixed ditto, first quality, 8*l.* 16*s.* to 9*l.* per ton; ditto, second quality, 8*l.* 12*s.* per ton; iron from first quality charcoal-made pig, 9*l.* 4*s.* to 9*l.* 8*s.* per ton; ditto, second quality, 9*l.* per ton. Machine iron is dealt in by continuation at 10*l.* to 10*l.* 8*s.* per ton for No. 20 puddled charcoal-made, 9*l.* 8*s.* to 9*l.* 12*s.* for No. 20 mixed, and 8*l.* 16*s.* per ton for No. 20 coke-made. A large meeting of industrials has just been held at St. Dizier for the discussion of trade questions; the forgemasters of at least a score departments responded to the appeal made to them by their Champagne *confreres;* the meeting, of which we may, perhaps, be enabled to give some further details, was closed with a banquet. Iron has been sustained in the department of the Ariege at preceding rates, and some rather active transactions have taken place in that part of France. The Foix Consultative Chamber of Arts and Manufactures, after having read a circular from the Minister of Commerce, under date Nov. 23, 1869, declared that it refused to send delegates to an administrative enquiry into the state of French industry, and that it greatly desired that the proposed administrative enquiry should be replaced by a parliamentary enquiry. The markets of the North and East of France remain in much the same state as in preceding weeks, and the same report may be made of the Paris iron market.

Reference was briefly made last week to a general meeting of industrials held at the Hotel du Louvre, at Paris, under the presidency of M. Ponyer-Quertier. This gathering decided on the formation of a central committee, composed of 20 members; the *role* of this committee will be the establishment of communications with all local interests, and the collection of a preliminary enquiry with a view to their communication to the *Corps Legislatif*. A manifesto, too long to be reproduced in its entirety, was unanimously approved of by the meeting. In this manifesto the assembled delegates declared that they refused to appear before the Superior Council of Commerce, because that council, composed now almost exclusively of the same men as in 1860, offers no guarantee against a return to the "same sad errors which have occasioned such unfortunate injury to French interests." A *senatus consultum* of Sept. 8, 1869, having given the French legislative body the right of fixing in future customs tariffs, the delegates of the National League—the name assumed by the "caucus" of the Hotel du Louvre—ask for a denunciation before Feb. 4, 1870, of the treaty concluded with England. They also ask not to be sacrificed, they and their workmen, to foreign producers and workmen, who do not participate in the charges under which they represent themselves to be succumbing. "We are not prohibitionists," say the delegates; "we do not speculate on protection. Whatever may be our sufferings, we do not ask that an additional sentime of duties should be imposed upon foreign products so long as the deputies of the country, our natural judges, have not recognised the necessity of them. We call for a loyal enquiry, in which all French interests shall be heard. We ask for a parliamentary enquiry; and, strong in the justice of our cause, we await with confidence the decree which may be issued on the subject."

Copper has not acquired an improved tone in France; great inactivity, indeed, prevails, and former prices, although low, have scarcely been maintained. At Havre no affair of importance has been carried through; Chilian in bars has been quoted at 68*l.* per ton, Paris conditions; refined Chilian in ingots, 72*l.* 8*d.*; pure Peruvian mineral, 70*l.* to 70*l.* 8*s.* per ton. United States (Baltimore) and Lake Superior copper have made default at Havre. At Paris, Chilian in bars has made 68*l.*; ditto in ingots, 72*l.* 8*s.*; and Corocoro mineral (pure copper), 70*l.* per ton. The German copper markets have been generally quiet. At Hamburg transactions in copper have been limited, and prices have displayed no variation. At Rotterdam, Drontheim has made 50 fls. to 52 fls. Tin has displayed an unfavourable tendency upon the German markets, and has been rather neglected. There has also been a slight reaction upon the Dutch markets; Banca has made 66 fls. and 64½ fls., as regards deliveries to be nominally made in the spring; Billiton is obtained easily, at 66 fls. French lead has made 19*l.* per ton at Paris; Spanish, 18*l.* 16*s.*; English, 18*l.* 16*s.*; and Belgian or German, 19*l.* per ton. Upon the German markets the price of lead has been quite stationary. There has been no variation in the price of zinc of late at Paris. At Hamburg a slight tendency has appeared to lower rates; there has not been a very large amount of business doing in the article.

The Royal School of Mines, Jermyn Street.

MR. WARINGTON SMYTH'S LECTURES.

[FROM NOTES BY OUR OWN REPORTER.]

LECTURE XII.—Mr. SMYTH commenced by enumerating a few books treating on matters connected with metallic deposits on which he had previously lectured. The chapters on lodes, in the Geological Reports of Cornwall and Devon and West Somersetshire, by Sir Henry de la Beche, contain a great deal of important information; and with regard to the North of England, Prof. J. Phillips, of Oxford, on a smaller scale, has published an excellent manual "On Mineral Veins." On the same subject "Willan on the Mica Veins of Alstone Moor," is a useful treatise. Dealing with the subject of exceptionably large lodes, the German and French scientific periodicals are full of information. Another excellent work is M. Burat's "Geologie Appliquée," in two volumes, but the details are not full enough for the actual miner. Amongst the works dealing more particularly with the stratified deposits, and especially with the working of coal, I may mention those of Prof. Cotta, of Freiberg; one entitled "Crzlage-stütten," and another called "Gangstudien"—Pryce's "Mineralogia Cornubiensis," and a Hungarian writer, named Delius. With respect to gold and silver ores, the recent works of Mr. J. S. Phillips, on "The Mining and Metallurgy of Gold and Silver," and of Mr. B. Brough Smyth, on the "Gold Fields and Mineral Districts of Victoria," are highly to be praised. A great deal of the literature of this subject lies hidden in official reports and serial publications of a scientific character, not only in this country, but in other countries, as, for instance, Puffendorf's "Annales des Mines," and certain of the archives published in North Germany. Of these works a great many have been brought together in the library attached to this institution, which is the richest in such works to be found in England.

To complete the subject of following up the indications of mineral veins in a new country or district, it may be necessary to consider some precautions necessary to be taken before opening a mine. A curious notion has been held by some persons that ore stones found in sand or gravel were capable of being formed there, and did not owe their origin to neighbouring lodes or beds. This idea was broached at first in Siberia, in respect to the lumps of ore found there in detrital deposits, like the nuggets of more modern days found in Australia, and it was alleged that their particles were brought together by accretion, or in some way by mutual attraction or affinity, and were not necessarily obtained from pre-existing veins or lodes. More recently the same idea has sprung up in Australia; and it is, therefore, as well to be on guard against the adoption of so unscientific a conclusion. It it true that in many gold workings the precious metal is found disseminated through sand and such like material, and no traces of a lode may exist, but the explanation is to be found in the researches and reasonings of geological science. Thus, at one time the mountains were enormously higher than they now are, but in the lapse of ages these surfaces have been by a variety of action brought down to lower levels, and to the bed of streams in the valleys. This denudation has taken place on so large a scale all the world over as to fully account for the gold and other deposits in alluvial beds. In the present day hardly enough attention is bestowed upon the search for shode stones, if their great practical importance be considered. It is notorious that great mistakes are made with regard to the indications shode stones give as to the position of lodes. First of all it is not readily understood how stones from the lode can reach the surface through 10 or 20 ft. or even 30 ft. of detrital material which covers the top. This has often caused it to be thought that when the stone is there the lode must be, and those who have acted on this idea have invariably been disappointed. There is, in fact, a tendency in everything at the top or sides of hills to travel towards the bottom. The progress may be slow, and extend over untold ages, but it is none the less a fact for that. Even the strata themselves, although they may for many rods or even fathoms be beautifully straight, yet as they near the surface show a curvature sometimes slight and at others considerable in the direction of the bottom of a hill. The practical result is that where a shode stone is found at the surface that is not the place to sink if you wish to find the lode. The fact is that shodes have invariably travelled, and in some cases from considerable distances. As hills vary in their angles of inclination, and the quantity of material upon them, the true outcrop from whence these stones have proceeded will be found at greater or less distances. Those who keep their eyes open may see even in road sections instructive examples of this sort of thing; and if the alluvial cover be large the distance the stones have travelled will be the greater. If we would carefully test phenomena of this sort on the ground it will be necessary to look over the surface, and judging by its formation to put down, perhaps, a succession of shoding pits. As long as we continue to find shode stones we may conclude we have not yet reached the lode, but if there are none that we have passed by it, and must try back till we find it.

When a lode has been discovered there must be a great deal of careful consideration before we make an active start with our operations—as, for instance, whether the lode makes its ore at the beginning, or whether we shall have to go down to a great depth before obtaining any remunerative produce. Sometimes we might have to begin by taking away the material at the surface, as in the case of the workings at Aue, near Schneeberg, where the cover had to a great extent to be removed, and was profitable, as it proved to be an accumulation of china clay. When we know what form our workings will take, or if we are dealing with regular beds, in which case there would be less difficulty as to the form, there is still a great deal more to be considered. In certain districts the ores are not expected to make up to the surface of the ground, and I have already quoted instances of gossans as much as 40 fathoms thick. In such cases it would be a mere waste of time to occupy ourselves with a series of shallow workings, which, however advisable in mining of another character, would be utterly useless in this. If in the back or broil of the lode, as it is called, we should find precious metals in small quantities, it is desirable to ascertain the exact proportion in which they exist. This is done with the assistance, in the first instance, of the convenient mechanical assay called "vanning" or "panning," in which a small portion of the material is taken up in a shovel or a shallow bowl, with water, and the refuse gradually separated and shaken out of it, leaving the gold or silver ores, or other valuable substances of high specific gravity, for closer inspection. If the gossans be thus proved to contain a share of such minerals, and there is a fair prospect of their continuance, care must be taken to get a fair average sample of the whole, and not one taken from any particular spot. In doing this, therefore, the proper mode will be to take a portion from a number of places on the outcrop, break them up small, and heap them in a large pile. These should be well mixed, and the pile cut through, dividing it into four quarters. A shovelful should be taken from each quarter, put together in a heap, and the operation repeated. In this way a small quantity will be obtained to be sent to the assayers, which would give the true value of the real quality of the lode. It is likely that in gold and silver deposits there will be small nests or portions of richer vein stone, to say nothing of nuggets or free gold, which will give a much larger profit than samples of the whole vein would indicate. These will always be looked for anxiously where there are intersections by other veins, but they should not be depended on in making calculations. The ordinary produce of the lode must be looked to for payment of the current expenses, while the richer parts and the nests should be left to swell the profits. It is dangerous, indeed, to trust to these accidental riches, and there are instances enough of companies being got up, and a large capital subscribed, upon the faith of assays which have not been taken from the whole lode, but from certain spots, and which, therefore, have ended only in disappointment and loss. With regard to the precious metals, there has always been a strong belief that when met with at the surface they are apt to go out at comparatively small depths. This may hold good in certain districts, but it is not right to allow ourselves to be influenced by what in others is a mere prejudice. In Europe, at any rate, experience has gone rather in favour of that idea. In the cobalt mines of Schemnitz, for instance, they used near the outcrop to obtain native gold; at a medium depth—say, from 50 to 150 fms.—the vein yielded its richest ores of silver, while at the extreme depth of 250 fms. all the richer deposits appear to have ceased, and what the vein there produced was galena and gold-stamp-stuff, allowing a fair percentage of profit, but the veins no longer yielded gold in a visible shape. At Transylvania, at Salzburgh, in the Tyrol, the same thing has happened. In the New World no such great depths have yet been obtained, but some of the silver mines of Mexico have yielded richly to great depths; and at the famous gold mine of St. John del Rey the lode at 160 to 180 fms. appears yet to contain gold so as to remain a profitable enterprise, so long as accidents do not occur to the mine, and the proportion of yield was not very different in the deeper to that of the shallower workings. In California and Australia a great deal of anxiety has been naturally felt as to whether the lodes there may be expected to yield to depths as great as those of the St. John del Rey Mine? They have not yet descended more than 500 or 600 feet, but at present the yield of gold remains as good as ever, and, indeed, is expected in many places to be richer. On the whole, it will be safer to take it, that the lodes will be likely to diminish rather than increase in richness, although, of course, there will naturally be many exceptions. One European mine, however, furnishes a remarkable example of increasing riches. A silver mine at Przibram, in Bohemia, was commenced in 1783 on a magnificent specimen of lode structure of a banded kind. In 1785 the yield was 2 loths. or 1 oz. of silver, and 20 lbs. of lead from 100 lbs. of lode stuff. From that year to 18 0, as the mines became deeper, the quantity of silver which the ores averaged was 4 or 5 loths to the hundredweight of material raised. In 1820 it had increased to 7 loths; in 1850 to 8 loths; and in 1860 to 9 loths, which the mines continued to yield, even at the great depth of 360 fms. distance from the surface. I was in that district this year, and the depth now attained is about 450 fms., with nothing to indicate any approach of poverty of ground.

There are one or two reasons why it is necessary to recognise whether we are dealing with a lode or bedded stratum, or only with an irregular deposit. Thus, supposing we have three mining properties of equal surface area, adjoining each other, and think we are dealing with a lode which may exist in one only, we may purchase the next sett, and find it cuts off abruptly, instead of going on like a true lode; or, on the other hand, it may be continued in a way which would make it most desirable for the miner to obtain the one or other of the adjacent setts. If it be a bed the case is very different, and unless it be contorted, or there be a fault, we may calculate on its continuance within certain known limits.

Before we go into the subject of actual mining there are certain considerations to be taken into account which, for convenience sake, may be divided as follows—

1.—First of all, from whom and on what conditions and for what length of time a mining area is to be obtained—that is to say, whether it would have to be held under a long or short lease. If it be for a long period the system may be greatly modified. Then, the nature of the partnership under which it is to be worked is very important. With regard to collieries, the machinery to be erected on the surface to work the mine, or in other mines to bring the material into a better state for the market, are considerations of importance—as, for instance, the planing and sawing of slate or slabs is oftentimes so costly and so considerable that a longer period than the usual term of 21 years should be attained, particularly if in sparsely populated districts cottages have to be built for workmen. In coal or ironstone mines no one would be justified in going to work unless he had a sufficient area of the mineral, as well as a proper length of time, to recoup the outlay with a fair amount of profit; and, on the other hand, it would be of no use to lay down the machinery necessary for a large daily output, based upon a 50 years calculation, if you can only have it for 20 years, with uncertainty as to what may happen at the end of the shorter term.

2.—We must next consider what motive power, if any, is at hand to employ for our machinery; whether we can have water power, which is cheapest, or if not water or not enough of it, whether fuel (wood or coal) would have to be obtained at a distance, and what are their respective prices. Speaking generally, as far as this country is concerned, there is in the hilly districts sufficient water, although it may have to be collected in reservoirs and brought some distance. In Cardiganshire, near Aberystwith, there are cases where the water thus collected is carried from four to six miles, and in this way the mines there are worked with great economy. It must also be recollected that the height from above the sea level as affecting the climate is important. In some instances great difficulty arises from the continuance of frost and snows, as in Norway, where the water is all frozen up in October, and no more to be had until the thaws of spring. In such regions the water in the mine does not freeze, but continues to rise, and the outlets being frozen up it may drown the miner. From circumstances of this kind the mines opened on the lodes of the French Alps can only be worked for five months in the year. Nevertheless, in the Hartz, at Freiberg, in Saxony, and at Schemnitz, in Hungary, the supply of water power is managed with great success, the water being brought 12 or 14 miles, notwithstanding all the difficulties produced by severe frosts, which seal up the sources of water power. Again, if the supply is obtained too near the heads of streams it cannot be expected to be steady. There may be more than is wanted to-day, and not enough for to-morrow, so that it is necessary to construct reservoirs. Reasons of this kind may render it better, even if the cost be greater, to use steam power, as is almost invariably do in the South-Western districts of England. In some countries the climate is so injurious to health that Europeans are compelled to remove to other localities during a part of the year,—a circumstance to which, when on road, the engineer must attach due weight.

Difficulties of this kind are sometimes insuperable, and thus in the French Alps, which rise a great height above the sea level, mines have had to be abandoned, not on account of scarcity of ore, but because they could only be worked three or four months in the year, and the men could not be kept steadily at work even in those months. Other districts present obstacles, because water cannot be obtained even for the men to drink, as, for instance, in some of the richer districts of Southern Spain, much less for dressing the ores, and the precious liquid has to be carried for miles upon the backs of mules. The dressing has also to be done with the assistance of the wind, and I need hardly add very inefficiently.

3.—What means of communication with other districts or carriage exist; whether by road, canals, railways, sea, or horse carriage. On the Fells, in the North of England, where the mines lie miles and miles away from any road, they carry the ores upon ponies or galloways, and abroad mules are employed with great economy. Carriage, however, of this kind, cannot compete with carriage, on ordinary roads, to say nothing of railways. Miners are better off in this respect than they used to be, and, therefore, deposits of a poorer character can be worked to advantage which formerly could not.

4.—Whether suitable kinds of wood are attainable on the spot for securing the workmen and keeping open the levels by props. Fir or pine, good larch, and oak are the most useful sorts of timber, and the cost of them, and the distance they have to be brought, are matters of importance. In some districts in Europe, as in Styria, where large smelting works are established, and in America, where woods are near the rivers, timber for mines is floated down the streams very cheaply. In the Cornish mines, where enormous quantities of timber are used, and where it is not to be had in the neighbourhood, they are entirely supplied from the Baltic at an extremely reasonable cost of carriage.

5.—The wages of skilled and unskilled industry in the neighbourhood of the mine, and the proximity or otherwise of the dwellings of the workmen. You will find that in commencing a mine in remote districts this labour question will be one of difficulty, and you will have to build barracks or dwellings of some kind on the spot, or much time and strength will be wasted in going to and fro. And the rate of wages is a matter of equal importance. In some places, where the price of labour has risen to a great height, as in California, it is impossible to work any but the richest deposits. In Hungary the contrary is the case, and, therefore, mining there, although often in poor ground, is not unprofitable. Another point of the greatest importance is the skill and intelligence of the workmen. Nothing is easier than to mar a mine by indiscreet directions, and get it into a bad shape, whereas it will cost a great deal of time and money, and nothing is more difficult to restore it to a good form for working.

6.—So far as above-ground arrangements for a mine are concerned, the first thing to be done is to establish an office, a dwelling for the overlooker and others, carpenters' sheds, a smiths' shop, places to store materials, and various indispensable fixtures of a like character. These things must be done when a commencement is resolved upon; but it would be a foolish thing to build offices of this kind on a large scale and in a permanent manner until something certain is known of the lode. I remember a case in which, in addition to other buildings, extensive and complete, a house was erected in which the adventurers were to divide their dividends, but which, unfortunately, never came into existence. Mining engineers, however, must be equally careful not to err on the other side, if necessaries, such as I have mentioned, have to be brought or fetched from a distance that will involve loss of time, which means loss of money. When works acquire any magnitude a considerable quantity of accommodation is required, and, therefore, whatever buildings are put up at the commencement should be designed so that they may be enlarged as required. As regards machinery, it must be remembered that while a due regard to economy cannot be too highly praised, niggardliness very rarely effects any real saving. People sometimes, for the sake of a smaller present outlay, put up a steam-engine which barely does what is required from it, and then as the work increases it is overstrained, and delays often occur from breakages to such an extent as to more than outweigh the supposed saving. It is always better to have machinery rather more than less powerful enough for the work required, and then everything is done with ease and economy. As an instance of vast outlay in surface works, at a colliery near Anzin, in Northern France, many thousands of capital have been expended, and the buildings include large granaries, store houses, fitting-up shops, and a foundry for casting. The amount of coal raised is enormous, and several thousands of workmen are employed in these collieries.

LECTURE XIII.—Having examined various modes of searching at the surface for mineral veins and stratified deposits of a valuable character, and the opening of such veins and deposits as preliminary to the more regular mining, we will now proceed to the subject of "deep boring." Exploratory operations have been already explained as being chiefly of two kinds—that is to say, either shafts or levels, the former being sunk perpendicularly from the surface, and the other driven horizontally in the hill side, as a gallery or tunnel, or from the bottoms or sides of shafts in the mine itself. Levels of the latter kind are also of importance very frequently with regard to drainage as well as exploration. A good deal must depend upon the character of the ground with regard to those portions of it which are likely to be ore bearing. For example, if the ground be of the same quality, and we work from a valley, it will be necessary to go down many fathoms, and work it out by levels, and then the drainage will be effected by pumping the water out of the shafts, but to follow this rule on a mountain top would require a greater expenditure than is compatible with wisdom. It is imprudent, also, to multiply our levels unduly, and to go to too great an expense in that way. I recollect a case in Ireland where exploratory drifts were put in so near each other that the expenditure was at least double what it ought to have been. It does not always follow that the deepest shafts are those that have been most expensive; much depends upon the nature of the ground to be pierced. One of the earliest sources of expense arises from the necessity in most grounds for pumping out the water, and allowing the men to proceed with their work, and it has been found that by the use of boring apparatus much of this may be avoided. These bore-holes are put down without any necessity for men at the bottom. They are generally small when intended for exploratory purposes, and the apparatus acts all the better for the hole being full of water. Indeed, when the strata are dry water is poured in from the surface. It is a mode of perforating the earth's crust to a great depth by means of implements alone, and for a variety of purposes, sometimes when it is impossible to sink shafts. These holes vary in diameter from 1¼ inch to 6 feet in general, and their depth may be from a few feet to 3000 feet, as in the case of the deep boring at Creuzot, which was put down to that depth for the purpose of exploring the strata for coal known to exist in the neighbourhood. These bore-holes are used for four different purposes—viz.:

1.—For testing the character of the ground to a small depth—say, 30 to 60 feet—for the purpose of finding a good foundation for buildings, or to estimate the cost of the railroad cuttings.

2.—For exploratory, precautionary, or incidental purposes in mining. In exploring, for instance, to prove the existence, position, and thickness of geological beds, as masses of iron ore or seams of coal found in the North of England.

3.—For relieving the upper workings of a mine from water when it can be tapped off, and also for establishing communications for air, and for the ventilation of certain places.

4.—To afford access to subterranean waters, whether pure for the supply of towns and factories, or brine from which salt is obtained by evaporation.

With regard to the first of these classes, the bore-holes are usually sunk to depths of moderate amount, for the purpose of testing the foundations of bridge piers, or of large buildings, as St. Paul's cathedral, respecting which the careful borings of Sir Christopher Wren are on record—not only as to the ground on which he afterwards piled up such a massive weight, but he also carefully bored that which lies adjacent to it. Very frequently in the case of a railway cutting it is necessary to ascertain the hardness and character of the material to be cut through, in order to estimate accurately the probable cost of the work.

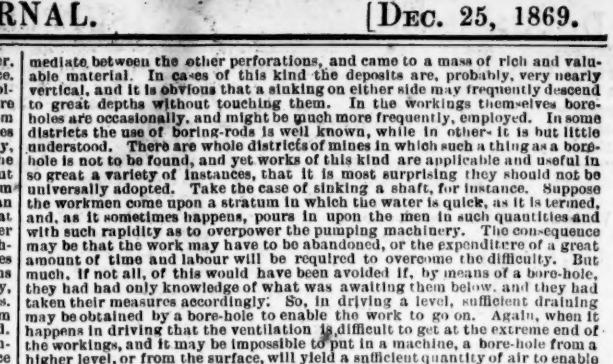
In the second place, bore-holes come into play in dealing with stratified rocks. Sometimes for the purpose of discovering what the ground consists of below, and at other times it may be required simply to determine the thickness of a particular seam, or the depth at which it occurs. Thus, the problem will be of two or three different kinds. In the first place, bore-holes will vary both in number and extent, even in the same districts. It is not always necessary to go to the bottom of a bed, because its very nature when reached sufficiently tells us what we want to know. Supposing we have a coal field which at a place we will call A is well known, while at B adjoining it has not been worked at all, it will not be necessary to bore in the latter if faults and disturbances are not common in the district. At the same time, the thickness of beds varies very much, although they may continue unbroken and undisturbed. In borings of this exploratory character it is obvious that much information may be gained as to the position, depth, and thickness of the beds we desire to reach; but the greatest care is generally necessary to see that the workmen do not, by carelessness or inadvertence, lose the full use of the work. I have seen cases where a seam of coal 6 feet thick has been bored through, and the men have taken no notice of it, and it is possible that sometimes men may be bribed not to notice the existence of particular beds if found; but, whatever the cause or motive, the result of such carelessness is the same to the engineer and his employers. I have, on the other hand, known instances in which coal was brought up from a bore-hole into which it must have been surreptitiously thrown down for the sole purpose of getting "a good feed" for the men, and a holiday for the neighbourhood, on account of the joyful discovery. It is important, then, to employ the most respectable men that can be had, and have a bore-master on whom reliance can be placed, and also to have some one at hand in those portions of the borings in which, it may be from known facts, good results are looked for. In the important irregular repositories of ore in the districts of Ulverstone and Whitehaven boring plays a conspicuous part. Valuable masses of iron are found there in a variety of strange and unexpected forms, covered up with many feet of sand or clay, and to which, therefore, there is very little clue at the surface. In these districts the owner, or persons who obtain a grant for that purpose, put down a series of bore-holes in search of the valuable minerals. This is a work of great uncertainty, because although it is known that riches are near, from the eccentric and irregular character of those repositories it is quite easy to miss them altogether. Some remarkable instances of this kind have occurred. In one case three or four bore-holes were sunk in one field without touching anything, and it was given up as useless; but a long time afterwards new adventurers tried again, by putting down a bore-hole in the space intermediate between the other perforations, and came to a mass of rich and valuable material. In cases of this kind the deposits are, probably, very nearly vertical, and it is obvious that a sinking on either side may frequently descend to great depths without touching them. In the workings themselves bore-holes are occasionally, and might be much more frequently, employed. In some districts the use of boring-rods is well known, while in others it is but little understood. There are whole districts of mines in which such a thing as a bore-hole is not to be found, and yet works of this kind are applicable and useful in so great a variety of instances, that it is most surprising they should not be universally adopted. Take the case of sinking a shaft, for instance. Suppose the workmen come upon a stratum in which the water is quick, as it is termed, and, as it sometimes happens, pours in upon the men in such quantities and with such rapidity as to overpower the pumping machinery. The consequence may be that the work may have to be abandoned, or the expenditure of a great amount of time and labour will be required to overcome the difficulty. But much, if not all, of this would have been avoided if, by means of a bore-hole, they had had only knowledge of what was awaiting them below, and they had taken their measures accordingly. So, in driving a level, sufficient draining may be obtained by a bore-hole to enable the work to go on. Again, when it happens in driving that the ventilation is difficult to get at the extreme end of the workings, and it may be impossible to put in a machine, a bore-hole from a higher level, or from the surface, will yield a sufficient quantity of air to enable the men to work. I have been chiefly speaking of vertical, or nearly vertical, borings, but horizontal borings, in a great number of instances, are indispensable. Supposing the miners are obliged to approach nearly to ancient workings—old mines which stand full of water, which is a frequent case in coal districts—if they should come suddenly upon one of these reservoirs the water rushes in upon them, and, in all probability, where there is no chance of escape, and a great loss of life ensues in all the lower workings. How, then, to avoid such a catastrophe is an important question, and it is found that the only chance of safety is obtained by keeping bore-holes sufficiently in advance of the workmen; indeed, it is now rendered obligatory, by an Act of Parliament, that when the miners are approaching old workings bore-holes shall be kept in advance ahead of the workmen in the new drift. These exploratory bore-holes should always be run in pairs, one on each side of the drift, and four or five yards in advance, so that when the men drive a yard of the level the bore-holes should be advanced a yard. But it may be said that if the bore-hole should tap any concealed reservoir of water, or accumulation of water in an old sump, the water would rush through the bore-hole, and although not so rapid, sufficiently so to be dangerous. The borers, therefore, have a long tapering plug, to fit the orifice, which being thrust into the bore-hole is tightened at once with a few blows from a mallet, and the opening is again secured. The water may then be let out by degrees, and so the whole quantity may be tapped off, and the workings relieved from such a source of continual danger. But, generally speaking, it is not sufficient to keep one bore-hole, simply in advance, as it is obvious that old workings may, and indeed frequently do, take irregular forms, and there are cases in which, in spite of precautionary bore-holes, the water has burst through suddenly, and with a great pressure bearing all before it drowned a great number of men. It is, then, obviously necessary to have flanking bore-holes as well as those in advance, so as to feel the way, and to insure there being a sufficient barrier of firm ground betwixt the workings and the danger. Notwithstanding every care, accidents from this cause will sometimes take place.

A very fine colliery was destroyed a few years ago in this way. The old workings were known, and the manager, who at first proposed to leave 20 yards of ground between them and the new workings, increased that barrier to 40 yards; but in spite of every precaution—and they had bore-holes in advance—the water was tapped, and burst through with terrific force, carrying away to destruction 40 men who were at work. The fact was, the old miners had put down a sort of drainage sump, which, by great neglect, was not shown on the maps, and of which the bore-holes gave no indication. Again, cases sometimes occur pregnant with great danger, in which precautionary bore holes may be of great service. A thick seam of coal will sometimes be divided by a band of dirt, and the upper portion may have been worked, the lower one being left to the last. In working the lower seam it is clear that, although you may keep a bore-hole in advance, you must, unless you know what has been done in the upper seam, run a great risk of the roof breaking away suddenly, the water running into your levels, and drowning your men.

Our third and fourth divisions refer to the reaching of subterranean waters or brine-springs when the bore-holes are put down at small distances from each other, and generally to moderate depths. When, however, we come to the supply of large towns with water, the operations are greatly magnified. Thus, in the gigantic bore-holes now sinking for this purpose at Paris, the works are carried on upon a splendid scale. One of these bore-holes is 6 ft. and the other 4 ft. in diameter: but, large as they are, they are worked with the orifices full of water. The only similar work in this country was that of the bore-hole sunk at Kentish Town, for the purpose of supplying a brewery with water, but without result, as the boring, after descending 200 fathoms, failed, from irreparable breakages of the apparatus. At Paris, however, there have long been two Artesian wells at work—those of Grenelle and Passy, both of large diameter, but not to be compared with the new ones now sinking. This application of boring to holes of such large diameter was first started by M. Kind in Westphalia, who began by boring a hole 4 feet in diameter, full of water, and then putting in a lining of sheet-iron, pumped out the water, and thus enabled the men to get to the bottom; but the great success which has attended these large operations during the last two or three years has invested them with much greater interest and attention than they obtained previously. Bore-holes with a diameter of 11 ft. to 15 ft. are now put down at far less expense than the ordinary cost of sinking.

Boring is effected by suspending a cutting-tool of a given weight to a rod or rope, and by letting fall it is made by its own weight to cut the ground at the bottom of the hole. After the bottom is thus cut to pieces the first tool is raised, and another lowered to remove the debris, the latter often being a kind of scoop, turned from the top by means of a cross-head. If the cutter sticks another apparatus is introduced. [Mr. Smyth exhibited a large collection of boring-tools, and explained the modes in which they were used.] The cutting-tools are edged either like an ordinary chisel, or T-shaped or curved. After every blow they are turned either by the hand of the borer at the surface, or, when the lift is effected by machinery, by some mechanical contrivance. In this way the whole of the bottom is equally acted upon. When the tools are lifted by means of rods, the latter are generally made of inch iron of the best quality that it is possible to procure. Let no one begrudge the cost of the very best; indeed, it would be better worth while to pay double the price of the best Low-moor iron than to use a material liable to fracture, because such an accident would not only occasion loss of time and difficulty, but might lead to the loss of the bore-hole altogether, as in the case of the Kentish Town boring.

The lecturer concluded by exhibiting specimens of the rods and other apparatus. A diagram on the wall, to which reference was made, showed the comparative depths of the principal shafts and bore-holes in the world, as matters stood four or five years ago. Since that period some of the bore-holes had been considerably deepened. The following is a copy of the table:—



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